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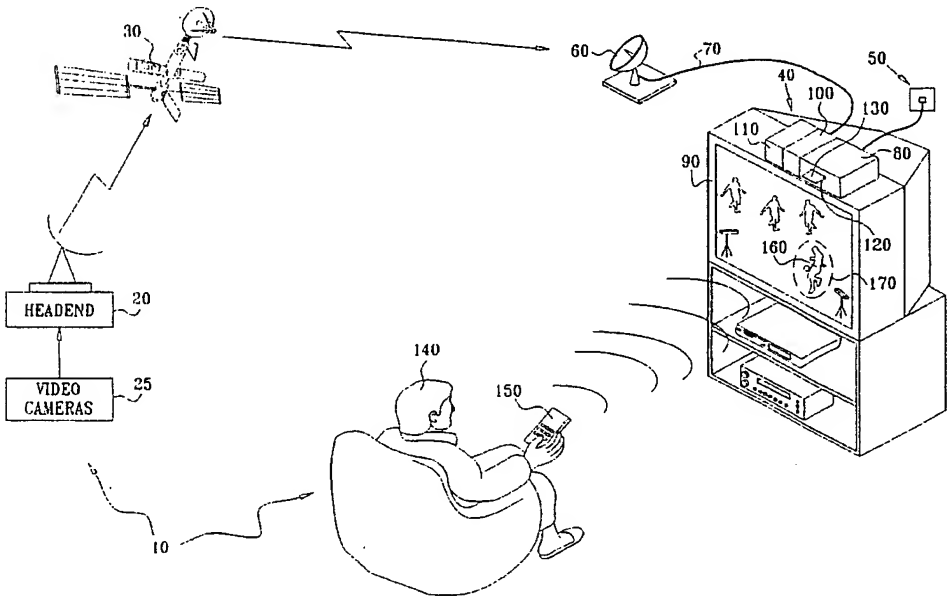
(54) Title: INTERACTIVE BROADCAST SYSTEM



(57) Abstract: An anticipatory processing system is described. The anticipatory processing system includes a controller generating a prediction of an event determining program material to be displayed, and an audio/video (A/V) processor controlled by the controller for preparing a digital stream for use in response to the prediction of the event. Related apparatus and methods are also described.

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INTERACTIVE BROADCAST SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority from US Provisional Patent Application Serial No. 60/422,348, filed 30 October 2002, the disclosure of which is hereby incorporated herein by reference.

FIELD OF THE INVENTION

The present invention generally relates to interactive systems such as, for example, interactive broadcast systems.

BACKGROUND OF THE INVENTION

In digital broadcast systems, such as digital cable television systems and direct broadcast satellite systems, there is typically a noticeable delay each time a viewer changes a channel. A noticeable delay also occurs before an advertisement is displayed at a commercial break in a program viewed on a channel, particularly in interactive television applications and applications that use personal video recorders (PVRs) in which advertisements may be personally manipulated and selectively displayed.

Such delays are typically due to processing time required for tuning and processing digital channels and for preparing information for display on digital channels. Reduction of such delays is considered desired for improving the viewing experience of a user of a digital broadcast system, particularly when the user utilizes interactive applications in which smooth advertisement display and smooth transition between channels are required.

Technologies that may be useful in understanding the present invention exist in various fields. For example, there are web sites, such as museum web sites, that allow multiple visitors to each take an individual "virtual tour" of a virtual museum and/or manipulate exhibits in the virtual museum. In such a case,

remote unit are arranged in a pattern that corresponds to the various camera views available.

US Patent 4,062,045 to Iwane describes production of 3D images by means of a plurality of TV cameras.

US Patent 4,931,817 to Morioka describes improvement in a process for producing works of sculpture.

US Patent 5,448,291 to Wickline describes a multiplicity of cameras, each of which produces a distinct image on a separate screen (e.g., screens placed above the stage in a theatre).

US Patent 5,659,323 to Taylor describes effects that can be produced prior to broadcast by having an arrangement of a multiplicity of cameras.

US Patent 5,703,961 to Rogina et al describes synthesis of images from a multiplicity of cameras to allow a viewer to change the angle of view when he moves his head.

US Patent 6,359,647 B1 to Sengupta describes automation of a multiple-camera system based upon the location of a target object in a displayed camera image.

US Patent 6,373, 508 B1 to Moengen describes path of a (moving) object within a picture. Also described is replacing, prior to or during the broadcast, the display of a tracked object with another (e.g. more clearly visible) object.

US Patent 5,714,997 to Anderson describes a virtual-reality TV system that allows a viewer to select viewpoints of a scene, and to receive sounds as they would be heard at that point.

US Patent 5,729,471 to Jain et al describes machine dynamic selection of one video camera/image of a scene from multiple video cameras/images of the scene in accordance with a particular perspective on the scene, an object in the scene, or an event in the scene.

US Patent 5,745,126 to Jain et al describes machine synthesis of a virtual video camera/image of a scene from multiple video cameras/images of the scene in accordance with a particular perspective on the scene, an object in the scene, or an event in the scene.

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The disclosures of all references mentioned above and throughout the present specification, as well as the disclosures of all references mentioned in those references, are hereby incorporated herein by reference.

It is appreciated that any regular channel may have a number of virtual channels associated with it. A regular channel may additionally or alternatively solely comprise a number of virtual channels.

There is thus provided in accordance with a preferred embodiment of the present invention an anticipatory processing system including a controller generating a prediction of an event determining program material to be displayed, and an audio/video (A/V) processor controlled by the controller for preparing a digital stream for use in response to the prediction of the event.

Preferably, the A/V processor is also controlled by the controller for preparing A/V information associated with the program material for display in association with the digital stream in response to the prediction of the event.

The A/V processor preferably prepares the digital stream for use by performing at least one of the following: preparing the digital stream for rendering, preparing the digital stream for storage, and preparing the digital stream for distribution via a communication network.

Additionally, the system also includes a display unit displaying the A/V information associated with the program material in association with the digital stream if the event occurs.

Preferably, the A/V processor, operating under control of the controller, uses the digital stream at a time after termination of preparation of the digital stream for use if the event occurs. The time after termination of preparation of the digital stream for use may be immediately after termination of preparation of the digital stream for use.

The event preferably includes at least one of the following: user input, an indication of a commercial break, an instruction from a headend or a broadcast source, an instruction from a computer program predicting user behavior based on a user profile, an alert associated with a current display, and at least one message from a broadcaster or a service provider.

Preferably, the program material includes a commercial. Alternatively, the program material includes a segment of a television program.

program predicting user behavior based on a user profile, an alert associated with a current display, and at least one message indicating current or scheduled occurrence of an event.

The controller preferably includes a stream selector for choosing any one of the first digital stream and the second digital stream from at least one of the following: a broadcast multiplex, and a plurality of digital content items stored in a memory.

Preferably, the second A/V processor, operating under control of the controller, renders the second digital stream after termination of preparation of the second digital stream for rendering if the predicted input is actually inputted.

Still preferably, each of the plurality of A/V processors includes a decoder for decoding an encoded data stream. The encoded data stream preferably includes an encoded video stream. Preferably, the encoded video stream includes an MPEG data stream and the decoder includes an MPEG decoder.

The MPEG data stream may preferably include an MPEG-2 data stream in which case the MPEG decoder preferably includes an MPEG-2 decoder. Alternatively, the MPEG data stream may include an MPEG-4 data stream and the MPEG decoder may include an MPEG-4 decoder.

Preferably, the anticipatory processing system also includes a display unit operative to display at least one of the following: audio content, and video content. The audio content preferably includes audio content outputted by the first A/V processor and the video content preferably includes video content outputted by the first A/V processor. The display unit may also preferably display video content outputted by the second A/V processor as picture-in-picture (PIP) images.

Additionally, the system also includes a content storage unit operative to store at least one of the following: audio content, and video content. The audio content stored by the content storage unit may preferably include audio content outputted by the second A/V processor and the video content stored by the content storage unit may preferably include video content outputted by the second A/V processor.

Each of the anticipatory processing systems mentioned above may be comprised in a cellular telephone.

There is also provided in accordance with a preferred embodiment of the present invention display apparatus for marking an object of interest on a display, the apparatus including an object determiner determining the object of interest based, at least in part, on user input, a position information receiver receiving, from a source remote to the display apparatus, information defining a position of the object of interest within a displayed picture, and an on-screen display (OSD) unit displaying a visible indicator at a display position on the display, the display position being based, at least in part, on the position of the object of interest. The apparatus may preferably be comprised in a set-top box (STB), where the STB is preferably associated with at least one particular viewer who is authorized to view the object of interest, and is operative to receive the information via a telephone message.

Preferably, the information is sent from a broadcast source or a headend. The information is preferably addressed to at least one particular viewer.

The object of interest is preferably operatively associated with identification (ID). Preferably, the object of interest includes a person. The person preferably includes one of the following: an actor, a player, and an audience member.

The position information receiver may preferably receive the information from the source remote to the display apparatus only upon generation of an indication of at least one of the following: knowledge of the person, and permission of the person. The indication is preferably generated at the source from an authorization list of parties with permission to track the person that is provided by the person.

Alternatively, the position information receiver may receive via the source a permission from the person to be tracked.

Further alternatively, the position information receiver may receive an indication of a permission to be tracked directly from the person.

Additionally, the method also includes preparing A/V information associated with the program material for display over the analog channel in response to the predicting.

Further additionally, the method also includes using the analog channel if the event occurs. The step of using preferably includes at least one of the following: rendering the analog channel over a television display, and recording the program material in a VCR.

In accordance with another preferred embodiment of the present invention there is provided an anticipatory processing method including providing a plurality of A/V processors including at least a first A/V processor and a second A/V processor, and instructing the second A/V processor, upon the first A/V processor rendering or preparing for rendering a first digital stream, to prepare a second digital stream for rendering based, at least in part, on predicted input.

Additionally, the method also includes rendering the second digital stream if the predicted input is actually inputted.

Also in accordance with a preferred embodiment of the present invention there is provided a display method for marking an object of interest on a display, the method including determining the object of interest based, at least in part, on user input, receiving information defining a position of the object of interest within a displayed picture, and displaying a visible indicator at a display position on the display, the display position being based, at least in part, on the position of the object of interest.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Reference is now made to Fig. 1 which is a simplified partly pictorial partly block diagram illustration of a preferred implementation of an interactive broadcast system 10 constructed and operative in accordance with a preferred embodiment of the present invention.

The interactive broadcast system 10 preferably includes a mass-media communication system which provides to a plurality of subscribers at least one of the following: television programming including pay and/or non-pay television programming; multimedia information; audio programs; data; games; and information from computer based networks such as the Internet.

The system 10 may be implemented via one-way or two-way communication networks that may include at least one of the following: a satellite based communication network; a cable or a CATV (Community Antenna Television) based communication network; a conventional terrestrial broadcast television network; a telephone based communication network; and a computer based communication network. It is appreciated that the system 10 may also be implemented via one-way or two-way hybrid communication networks, such as combination cable-telephone networks, combination satellite-telephone networks, combination satellite-computer based communication networks or by any other appropriate networks.

Physical links in any of the one-way or two-way networks may be implemented via optical links, conventional telephone links, radio frequency (RF) wired or wireless links, or any other suitable links.

By way of example, the system 10 is depicted in Fig. 1 as a combination satellite-telephone network in which a headend 20, or a broadcast source including, for example, a plurality of cameras 25, broadcasts program transmissions via a satellite 30 to a plurality of subscriber units. The plurality of cameras 25 may typically be placed to capture an event such as a sports game.

The broadcast source may broadcast the program transmissions either via the headend 20 or via other appropriate means, such as broadcasting equipment

insertion of A/V material, for example and without limiting the foregoing, for advertisement display, and to smooth transitions between channels and thereby to improve the viewing experience of the user 140. For example, the anticipatory processing system 100 enables the user 140 to comfortably switch between various scenes of a program transmission and to select different viewing angles of an event in the program. The anticipatory processing system 100 also enables, for example, smooth insertion of selected advertisements so that each advertisement may be viewed starting from its first frame and without losing frames due to channel processing delays.

By way of example, in Fig. 1 the program being displayed on the display 90 is an interactive sports game in which the user 140 may switch between different viewing angles of the game. The anticipatory processing system 100 preferably smoothes transitions between channels showing the different viewing angles of the game in accordance with selections made by the user 140.

The display apparatus 110 is preferably used for marking an object of interest, such as a person, on the display 90 to enable tracking of the object of interest by the user 140. If, for example, the object of interest is a person such as a player 160 in the game, a visible indicator 170 may be displayed on the display 90 at a display position, where the display position is based, at least in part, on the position of the object of interest. The user 140 may track the player 160, for example, by tracking the visible indicator 170.

Reference is now additionally made to Fig. 2 which is a simplified block diagram illustration of a preferred implementation of the anticipatory processing system 100 in the interactive broadcast system 10 of Fig. 1.

Preferably, the anticipatory processing system 100 includes a plurality of audio/video (A/V) processors 200 comprising at least a first A/V processor 210 and a second A/V processor 220. Each of the plurality of A/V processors 200 may comprise any suitable A/V processor such as, for example, a conventional A/V processor as found in conventional STBs. The anticipatory processing system 100 further preferably includes a controller 230 that controls at least the first A/V processor 210 and the second A/V processor 220 and preferably, but not necessarily,

controller 230. The MPEG unit 260 is also preferably operative to output clear content to a display unit 270 that is operative to display audio and/or video content, and/or to a content storage unit 280. The content storage unit 280 is preferably operative to store at least some of the audio and/or video content. The content storage unit 280 may preferably include an internal memory such as a solid-state memory or a hard disk (HD).

In a case where the transmissions received by the plurality of A/V processors 200 include analog audio and/or video content, the plurality of A/V processors 200, or some of them, may preferably include or operate as a plurality of tuners, the controller 230 preferably controls the plurality of tuners, and the content storage unit 280 may include, for example, a video cassette recorder (VCR). In such a case, the MPEG unit 260 may be optional. It is appreciated that each of the plurality of tuners may comprise any suitable tuner such as, for example, a tuner comprising conventional analog tuning and decoding circuitry as found in conventional analog STBs.

The controller 230 may preferably include a special-effects generator 290 for locally producing special effects. Preferably, the controller 230 is operatively associated with the following elements: the content storage unit 280; a processor 300; and a modem 310. The processor 300 may preferably include an on-screen display (OSD) unit. It is appreciated that the controller 230 and the processor 300 may be combined in a single processing element (not shown) that may be embodied in a single integrated circuit.

The processor 300 is preferably operatively associated with the following units: the plurality of A/V processors 200; the content storage unit 280; the modem 310; an input/output (I/O) unit 320; and a security element interface 330. It is appreciated that the controller 230 may also preferably be operatively associated with the I/O unit 320 and the security element interface 330, for example via the processor 300.

The I/O unit 320 preferably receives commands and other inputs from the RC 150 employed by the user 140. The security element interface 330 preferably provides an interface to a security element. The security element may preferably

After the digital stream is prepared for use, the A/V processor 210, operating under control of the controller 230, preferably uses the digital stream if the event occurs. For example, if the event occurs, the A/V processor 210 may display the A/V information associated with the program material in association with the digital stream on the display unit 270. Alternatively, the A/V processor 210 may provide the A/V information associated with the program material to the content storage unit 280 for storage therein, or distribute the A/V information associated with the program material. It is appreciated that the controller 230 may instruct the A/V processor 210 to use the digital stream at a time after termination of preparation of the digital stream for use. The time after termination of preparation of the digital stream for use may be, for example, immediately after termination of preparation of the digital stream for use or a later time.

The event preferably includes at least one of the following: user input; an indication of a commercial break; an instruction from the headend 20 or the broadcast source; an instruction from a computer program predicting user behavior based on a user profile; an alert associated with a current display; and at least one message from a broadcaster or a service provider. The program material preferably includes a commercial or a segment of a television program. It is appreciated that if the television program is an interactive television program, the segment of the television program may include any segment of the program, such as multimedia data accompanying the program, a broadcast segment of the program, etc.

Preferably, the A/V processor 210 prepares the A/V information for display in association with the digital stream by performing at least one of the following: preparing the A/V information for display over a channel associated with the digital stream; preparing the A/V information for display together with the digital stream in a picture-in-picture (PIP) mode; and preparing the A/V information for display together with the digital stream in a side-by-side mode.

A second preferred mode of operation refers to the above-mentioned case in which the transmissions received by the plurality of A/V processors 200 include analog audio and/or video content. Preferably, in the second preferred mode of operation the controller 230 generates a prediction of an event determining

220 to the display unit 270 for display in a picture-in-picture (PIP) mode together with the audio and/or video content outputted by the A/V processor 210, or to the content storage unit 280 for storage therein. If the second digital stream is stored in the content storage unit 280, the controller 230 may preferably retrieve the second digital stream for display on the display unit 270 at a suitable time.

In a case where the controller 230 generates the predicted input based upon user input, the user input may preferably include user channel changes performed by the user 140. The user channel changes may, for example, include a channel change in a first direction in which case the predicted input may be one of the following: a channel change in the first direction; and a channel change in a direction opposite to the first direction. The first direction may, for example, include exactly one of the following: an upward direction; and a downward direction. It is appreciated that the user channel changes may include changes between exactly one of the following: virtual channels; and regular channels.

Channel changes may also preferably be generated as a result of an instruction from the headend 20 or the broadcast source. The controller 230 may thus generate the predicted input based upon channel changes suggested or implemented by the headend 20 or the broadcast source and/or a combination of user channel changes and channel changes suggested or implemented by the headend 20 or the broadcast source.

The predicted input may also be used by the controller 230 to determine at least one favorite channel, for example, by determining a channel to which the user 140 returns many times during channel changing.

Preferably, the controller 230 or the display apparatus 110 may track a discrete object based, at least in part, on information concerning a path of the object. The discrete object may include, for example, a person appearing in a program transmission, such as an actor, a player, or an audience member. The controller 230 or the display apparatus 110 preferably tracks the person only upon receipt of an indication of at least one of the following: knowledge of the person; and permission of the person to be tracked.

time. Such user input is referred to throughout the specification and claims as "previous user input". The previous user input may include, for example, previous user channel changes, such as channel changes in a first direction.

Preferably, the previous user input is, at least partially, used for predicting a future input. For example, if the previous user input includes channel changes in a first direction, a predicted input may include a further channel change in the first direction, where the first direction is either an upwards direction or a downwards direction. Alternatively, if the previous user input includes channel changes in the first direction and a user behavior is detected in which the user 140 changes channels back and forth, the predicted input may include a channel change in a direction opposite to the first direction. In any case, it is noted that predicted input may be computed from information gathered on previous user input.

Once predicted user input is determined, then, while current images of a current channel accessed via one A/V processor, such as the A/V processor 210, are being displayed, another A/V processor, such as the A/V processor 220, may preferably begin processing images of a predicted next channel. When a channel change from the current channel to the predicted next channel occurs, the images of the predicted next channel may preferably be displayed much faster than in a conventional channel change in which the anticipatory processing system 100 is not used, or even seamlessly. This is because the processing of the images of the predicted next channel has already been carried out partially or even entirely before actual implementation of the channel change. The channel change is therefore executed smoothly and with a reduced delay when compared to a delay experienced in a conventional channel change that does not involve the anticipatory processing system 100.

It is appreciated that the controller 230 selects and controls the A/V processor 210 for accessing the current images and the A/V processor 220 for processing the images of the predicted next channel.

Smoothing of channel changes may be useful in many applications. Fig. 3 illustrates an example of the interactive sports game application mentioned above with reference to Fig. 1 in which smooth channel changes may be used to

Upon generation of predicted user input, the anticipatory processing system 100 may preferably begin processing, and if necessary storing, images obtained via camera 7 and camera 9 while images obtained via camera 8 are being displayed. If, for example, the A/V processor 210 is used for obtaining images captured by camera 8, the controller 230 may preferably instruct the A/V processor 220 to tune to a channel associated with camera 7 and an additional one of the A/V processors 200 to tune to a channel associated with camera 9. If additional A/V processors 200 are available in the anticipatory processing system 100, processing of channels associated with additional cameras, such as camera 6 and camera 10 may also be initiated while images obtained by camera 8 are being displayed.

Alternatively or additionally, background processing of images from more than one predicted path may be interleaved on a single A/V processor. For example, upon the A/V processor 210 accessing images being displayed, the A/V processor 220 may perform preparatory processing on a number of channels to which the user may tune. In such a case, the A/V processor 220 may preferably process, in parallel or in succession, different digital streams associated with different channels, and possibly even store information obtained from the different digital streams.

Each of the cameras 25 may additionally or alternatively be associated with virtual channels that refer to special effects of the cameras 25. One such special effect may include zooming as illustrated, for example, in Fig. 4 which is a simplified partly pictorial partly block diagram illustration of another preferred implementation of the game application depicted in Fig. 3.

Referring additionally to Fig. 4, the user 140 may have an option of zooming through camera 8', for example, by pressing a toggle zoom-enabled/zoom-disabled key (not shown) in the RC 150, where the symbol ' ' ' refers to a zoom of a normal view of a camera associated therewith. A zoom-enabled option for zooming-in or zooming-out may preferably be associated with a virtual channel associated with camera 8'. When viewing the game from camera 8', predicted user input may, for example, be channel changing to watch the game via one of the following: camera 8; camera 6'; and camera 10'. When viewing the game from camera 8 with

for the discrete views displayed at any instant to depend on a particular location currently being scanned via cameras taking images of the particular location. For example, scanning the playing field 400 through camera 1 followed by camera 2 may cause, in addition to the continuous moving camera view, a tickertape effect of selectable thumbnail discrete images to move across the bottom of the display 90.

In order to achieve such an effect, the anticipatory processing system 100 preferably receives information regarding which discrete pictures are associated with each camera and how to access them, the location on a screen of the display 90 for displaying each discrete picture when the current view is being shown, and how to shift the location of each discrete picture for each subsequent camera view displayed. Alternatively or additionally, the anticipatory processing system 100 may automatically exclusively associate each discrete picture with a cell in an array of locations at which to display the picture. A determination of the array may, for example, be stored in the content storage unit 280 of the anticipatory processing system 100, or stored in the STB 80 and accessed by the anticipatory processing system 100. It is appreciated that a location associated with each cell of the array may be predefined or dynamically updated in response to receipt of cell location data from the headend 20.

When a camera view changes, or when the number of discrete pictures to be displayed exceeds the number of location cells with which to associate them, or simply after a period of time, the excess previously received discrete pictures are removed and at least some of the remaining discrete pictures may be associated with a different cell either according to a predefined algorithm or as instructed by the headend 20. For example, if a tickertape effect is to be achieved and the user 140 is scanning cameras from left to right, each time a subsequent new discrete picture is to be displayed all previously received discrete pictures may be associated with a cell to the left of their previously associated cell, or removed if associated with the leftmost cell, and the new discrete picture may be associated with the rightmost cell.

Preferably, predetermined data associated with the cameras 25, such as data identifying the predetermined paths that the user 140 can take from each

instruction to alternate between a regular view and a zoomed view when switching between cameras; and an instruction to activate sound effects when switching to a specific camera. The sound effects may include, for example, a zoom sound effect or an indication of a required sound effect that is stored in the content storage unit 280.

The data related to association of regular discrete views with cameras is preferably used to indicate dependence of discrete regular views on images displayed by a current camera. For example, display of a regular discrete view may depend on a main image taken by the current camera in which the regular discrete view is displayed in a PIP form.

The data related to changes in distance between cameras is preferably used in a case where a distance between two of the cameras 25 varies. For example, if one of the cameras 25 is mobile, the data related to changes in distance between cameras may include a difference in positional values between the mobile camera and a static camera and a direction of travel of the mobile camera towards or away from the static camera. It is appreciated that the data related to changes in distance between cameras may be transmitted to the STB 80, or the STB 80 may generate such data from previous values if such values are transmitted to the STB 80.

The conditional access information may preferably be used to authorize the user 140 to manipulate camera views between the cameras 25.

It is appreciated that alternative patterns of arrangements of the cameras 25 may be employed depending on an environment in which the cameras 25 are placed. For example, if the cameras 25 are placed in a theatre, the cameras 25 may be arranged as a wall of cameras in which each camera is focused on a section of a stage during, for example, a live theatre production that is broadcast. In such a case, the user may employ the anticipatory processing system 100 in his STB 80 to individually change a view of the stage, zoom in on a particular actor, and perform other operations simulating his actually being in the theatre.

The anticipatory processing system 100 may also preferably be used to reduce zapping time during regular digital channel surfing in a broadcast system that is not interactive. Referring to a first example in which the user 140 zaps from channel 5 to channel 10, the system 100 may preferably start background processing

broadcast systems. For example, the anticipatory processing system 100 may learn that once the user 140 switches, for example, to a news channel, he is likely to switch to another news channel. Similarly, the anticipatory processing system 100 may learn other preferences of the user 140, such as preferences to view movies on movie channels.

In addition to normal user surfing behavior that the anticipatory processing system 100 may learn, the anticipatory processing system 100 may also predict user surfing behavior in a case where an alert or a message displayed on a current tuned channel encourage the user 140 to switch to another channel. The alert or the message may be displayed either in response to a previous request by the user 140 or a previous indication of interest by the user 140, or according to a determination performed at the headend 20. For example, an advertisement displayed on a current tuned channel may inform the user 140 that a product is about to be offered for sale on a shopping channel, or that a movie is about to start on a movie channel. In such a case, the headend 20 may preferably broadcast information comprising an alert relating to the channel being promoted, such as an ID of the channel being promoted, details of a product/service being promoted, etc. The anticipatory processing system 100 may optionally consult a user profile of the user 140 that may be stored, for example in the content storage unit 280, to ascertain that the product/service is indeed of interest to the user 140. It is appreciated that the anticipatory processing system 100 may implement a channel change to tune to the channel being promoted either in response to a selection by the user 140 or alternatively automatically.

The user profile of the user 140 is preferably based upon viewing information gathered within a time period and the anticipatory processing system 100 may preferably use such information for prediction of user input. For example, the user profile of the user 140 may show that the user 140 always watches the news at 5 PM on channel 22, but prefers to watch the fashion channel 20 at all other times. Therefore, when the user 140 presses an initial key '2' just before 5 PM, or perhaps even if the user 140 does not press any key, the anticipatory processing system 100

via a communication bus 530 or via other appropriate communication interfaces (not shown) that may be comprised in the display apparatus 110 or associated therewith.

It is appreciated that the display apparatus 110 may be used in the STB 80 in a configuration of the anticipatory processing system 100 of Fig. 2 in which the display apparatus 110 replaces the controller 230 or the processor 300, or is embodied in the controller 230 or the processor 300. In such a case, the object determiner 500, the position information receiver 510 and the OSD unit 520 may each preferably be operatively associated with each of the following elements of the system 100, for example via the communication bus 530: the plurality of A/V processors 200; the MPEG unit 260; the content storage unit 280; the modem 310; the I/O unit 320; and the security element interface 330.

In order for the display apparatus 110 to enable marking of an object of interest on the display 90, the STB 80 is preferably associated at least with the user 140 who is authorized to view the object of interest and may receive information via a telephone message. If the user 140 is authorized to view the object of interest, the display apparatus 110 becomes functional to track and/or mark the object of interest. In such a case, the object determiner 500 preferably determines the object of interest based, at least in part, on user input, and the position information receiver 510 preferably receives, from a source remote to the display apparatus 110 such as the headend 20 or the broadcast source, information defining a position of the object of interest within a displayed picture. Then, the OSD unit 520 preferably displays a visible indicator at a display position on the display 90, the display position being based, at least in part, on the position of the object of interest. It is appreciated that the information is preferably sent from the headend 20 or the broadcast source and is typically addressed to at least one particular viewer, such as the user 140.

The object of interest is preferably operatively associated with identification (ID). Preferably, the object of interest includes a person, such as an actor, a player or an audience member.

It is appreciated that the position information receiver 510 preferably receives the information from the source remote to the display apparatus 110 only

Referring for example to the sports game application mentioned above with reference to Figs. 1 and 3, each frame or group of frames that is sent by each of the cameras 25 may preferably be associated with a range of location values. The location values may, for example, include coordinates encompassing a length, a breadth and a depth covered by each camera. The coordinates may, for example, be a factor of the focus of each camera.

Each player in the sports game may, for example, wear a device that returns position information. For example, the device may include a reflector that enables triangulation by laser to determine position of the player. Alternatively, if the field-of-view of each camera is sufficiently large, the conventional Global Positioning System (GPS) may be used to determine position of the player wearing suitable means responsive to the GPS. Further alternatively, the position of the player may be determined by an image processor (not shown) associated with each camera. Using any of the above means and methods for determining position of the player, tracking information of each player may preferably be obtained at each instant and transmitted to the headend 20.

The headend 20 preferably compares each player's tracking information with location coordinates produced by frames of appropriate cameras at the same instant. Then, the headend 20 preferably translates the tracking information for each player into a series of ID numbers of those of the cameras 25 producing frames in which the players appear. The ID numbers of those of the cameras 25 producing frames in which the players appear are referred to herein after as "camera IDs".

Preferably, the headend 20 broadcasts the camera IDs together with associated tracking information of the players or location details of the players and IDs of cameras that are currently scanning the players' current location. Alternatively or additionally, individual tracking information of each player may be broadcast together with coordinates covered by each camera.

On receipt of broadcasts from the headend 20, the object determiner 500 preferably determines a specific player of interest, such as the player 160, based, at least in part, on input of the user 140. The position information receiver 510

be used as an ID for establishing an authorization for tracking purposes. Alternatively or additionally, the STB 80 may include or be associated with a conventional caller ID device (not shown) that shows an ID of a caller, and the user 140 may identify the audience member according to his/her ID displayed by the caller ID device. Further alternatively or additionally, the user 140 may have a predefined list of people that can call the STB 80 of the user 140.

It is appreciated that the headend 20 may transmit the camera IDs of all the cameras 25 or only the "best" camera IDs according to predefined criteria. The predefined criteria may be, for example, proximity of a player to a camera, proximity of the player to the center of a frame of the camera, and so on. Alternatively or additionally, the STB 80 may select the best views from received camera IDs. For example, the STB 80 may select a camera ID of a camera that is closest to a camera whose view the user 140 is currently viewing. This may particularly be useful in applications such as the game application of Fig. 3.

In the application of Fig. 3, if, for example, camera 2 and camera 5 both provide good views of a specific player, and the user 140 is currently viewing the game via camera 3, then the STB 80 may preferably select a frame associated with the camera ID of camera 2 as a view to offer the user 140 because camera 2 is in closer proximity to camera 3 than camera 5.

In a case where an effect of zooming is enabled as mentioned above with reference to Fig. 4, if the best view of a specific player is via camera 2', the user 140 may preferably be offered camera 2 and then if the user 140 wants to take a closer look, he can select camera 2'. The display apparatus 110 may be configured to give the user 140 the best regular view first, and then allow the user 140 to decide whether or not to zoom in. Alternatively, the display apparatus 110 may be configured to give the user 140 a corresponding zoom view when such a view is the best view available.

As an alternative to the headend 20 processing location information from the cameras 25 and tracking devices, such information may be broadcast unprocessed to the STB 80 where it may be translated into appropriate camera views.

It is appreciated that by using cropping and scaling of video images as mentioned above the headend 20 may keep track of the player or the audience member and enable display of an image of the player or the audience member in a reasonably fixed position on the display 90. OSD position may therefore be predefined leaving the headend 20 responsible for generating crop/scale factors accordingly.

During tracking of the player or the audience member, the player or the audience member may move to exit a first camera view taken by a first one of the cameras 25 and enter a second camera view taken by a second one of the cameras 25. In such a case, detection of object exit from one camera's field-of-view and entry into another camera's field-of-view as is well known in the art may be used in association with anticipatory processing as mentioned above for anticipating into which camera view the player or the audience member will enter next. It is appreciated that the second one of the cameras 25 may then preferably be given priority over other tuning options. If, however, the player or the audience member suddenly changes direction of movement, special effects such as "camera wobbling" and/or appropriate sound effects may be presented to the user 140. The special effects are useful for giving the effect that the user 140 is moving an actual camera which resists a change in its direction of motion while allowing the anticipatory processing system 100 to assign a higher priority to the camera field-of-view to which the player or audience member is now expected to enter.

If the player or audience member suddenly drastically increases speed, the anticipatory processing system 100 may change from assigning each next camera sequentially to assigning each second or third camera sequentially. For example, in an extreme case where someone is trying to track a supersonic jet flying past a number of fixed cameras, the anticipatory processing system 100 may assign priority sequentially to cameras 10, 12, 14, 16 etc and produce a blurring effect to simulate a single camera being moved very fast. A decision to skip over cameras may be based on information sent by the headend 20 or calculated by the anticipatory processing system 100 itself regarding the nature of the object being tracked, for example,

authorization to produce control words to decrypt encrypted broadcast material including the images of the person, or an authorization to tune to the channel.

Additionally or alternatively, a direct link may preferably be established between the cellular telephone of the person and the STB 80 before the STB 80 enables displaying of the channel in clear. It is appreciated that establishment of the direct link may be controlled or enforced by a device associated with the STB 80, such as the smart card 130. In such a case, the smart card 130 will not produce a valid control word if it does not receive information from a cellular telephone associated with the channel.

Further alternatively, the camera in the public place may transmit video images of the person to the cellular phone of the person in a case where the cellular telephone of the person has video capabilities. The cellular telephone of the person may then transmit the video images of the person, for example as part of a call session, to a receiving device (not shown). If the cellular telephone of the person includes the anticipatory processing system 100, the cellular telephone of the person may receive broadcasts from a plurality of public cameras, including video images and location data, and use anticipatory processing based on a direction of travel of the person to switch between camera outputs on transmission to the receiving device.

Reference is now made to Fig. 7 which is a simplified flowchart illustration of a preferred method of operation of the anticipatory processing system 100 of Fig. 2.

Preferably, an event determining program material to be displayed is predicted (step 600). Then, a digital stream is prepared for use in response to prediction of the event (step 610). Additionally, A/V information associated with the program material may preferably be prepared for display in association with the digital stream in response to the prediction of the event (step 620).

Preparing the digital stream for use preferably includes at least one of the following: preparing the digital stream for rendering; preparing the digital stream for storage; and preparing the digital stream for distribution via a communication network. After termination of preparation of the digital stream for use, the digital

first A/V processor rendering or preparing for rendering a first digital stream (step 810), the second A/V processor is preferably instructed (step 820) to prepare a second digital stream for rendering based, at least in part, on predicted input. It is appreciated that if the predicted input is actually inputted, the second A/V processor preferably renders the second digital stream (step 830).

Reference is now made to Fig. 10 which is a simplified flowchart illustration of a preferred method of operation of the display apparatus 110 of Fig. 6.

Preferably, an object of interest to be marked on a display is determined (step 900) based, at least in part, on user input. Information defining a position of the object of interest within a displayed picture is preferably received (step 910). Then, a visible indicator is displayed (step 920) at a display position on the display, where the display position is based, at least in part, on the position of the object of interest.

It is appreciated that various features of the invention which are, for clarity, described in the contexts of separate embodiments may also be provided in combination in a single embodiment. Conversely, various features of the invention which are, for brevity, described in the context of a single embodiment may also be provided separately or in any suitable subcombination.

It will be appreciated by persons skilled in the art that the present invention is not limited by what has been particularly shown and described hereinabove. Rather the scope of the invention is defined only by the claims which follow:

7. The system according to claim 1 and wherein said event comprises at least one of the following: user input; an indication of a commercial break; an instruction from a headend or a broadcast source; an instruction from a computer program predicting user behavior based on a user profile; an alert associated with a current display; and at least one message from a broadcaster or a service provider.

8. The system according to claim 1 and wherein said program material comprises a commercial.

9. The system according to claim 1 and wherein said program material comprises a segment of a television program.

10. The system according to claim 1 and wherein the digital stream is associated with a channel.

11. The system according to claim 10 and wherein the channel comprises one of the following: a regular channel; and a virtual channel.

12. The system according to claim 2 or claim 4 and wherein the A/V processor prepares the A/V information for display in association with the digital stream by performing at least one of the following: preparing the A/V information for display over a channel associated with the digital stream; preparing the A/V information for display together with the digital stream in a picture-in-picture (PIP) mode; and preparing the A/V information for display together with the digital stream in a side-by-side mode.

13. An anticipatory processing system comprising:

a controller generating a prediction of an event determining program material to be displayed; and

19. The system according to claim 17 or claim 18 and wherein the controller comprises a stream selector for choosing any one of the first digital stream and the second digital stream from at least one of the following: a broadcast multiplex; and a plurality of digital content items stored in a memory.

20. The system according to claim 17 and wherein the second A/V processor, operating under control of the controller, renders the second digital stream after termination of preparation of the second digital stream for rendering if the predicted input is actually inputted.

21. The system according to claim 17 and wherein each of the plurality of A/V processors comprises a decoder for decoding an encoded data stream.

22. The system according to claim 21 and wherein the encoded data stream comprises an encoded video stream.

23. The system according to claim 22 and wherein the encoded video stream comprises an MPEG data stream and the decoder comprises an MPEG decoder.

24. The system according to claim 23 and wherein the MPEG data stream comprises an MPEG-2 data stream and the MPEG decoder comprises an MPEG-2 decoder.

25. The system according to claim 23 and wherein the MPEG data stream comprises an MPEG-4 data stream and the MPEG decoder comprises an MPEG-4 decoder.

26. The system according to claim 17 and also comprising a display unit operative to display at least one of the following: audio content; and video content.

35. The system according to claim 32 and wherein the user channel changes comprise changes between exactly one of the following: virtual channels; and regular channels.

36. The system according to claim 17 and wherein the controller determines at least one favorite channel based, at least in part, on the predicted input.

37. The system according to claim 17 and wherein the controller tracks a discrete object based, at least in part, on information concerning a path of the object.

38. The system according to claim 37 and wherein the discrete object comprises a person.

39. The system according to claim 38 and wherein the person comprises one of the following: an actor; a player; and an audience member.

40. The system according to claim 38 or claim 39 and wherein the controller tracks the person only upon receipt of an indication of at least one of the following: knowledge of the person; and permission of the person.

41. The system according to claim 40 and also comprising a processor receiving said indication from at least one of the following: the person directly; a broadcast source; and a headend.

42. The system according to claim 41 and wherein said indication is generated from an authorization list of parties with permission to track the person that is provided by the person, wherein the indication is generated at one of the following: the broadcast source; and the headend.

51. A set-top box (STB) comprising the apparatus of claim 48, the STB being associated with at least one particular viewer who is authorized to view the object of interest, and being operative to receive the information via a telephone message.

52. Apparatus according to claim 48 and wherein the object of interest is operatively associated with identification (ID).

53. Apparatus according to claim 48 and wherein the object of interest comprises a person.

54. Apparatus according to claim 53 and wherein the person comprises one of the following: an actor; a player; and an audience member.

55. Apparatus according to claim 53 or claim 54 and wherein said position information receiver receives said information from the source remote to the display apparatus only upon generation of an indication of at least one of the following: knowledge of the person; and permission of the person.

56. Apparatus according to claim 55 and wherein said indication is generated at the source from an authorization list of parties with permission to track the person that is provided by the person.

57. Apparatus according to claim 53 or claim 54 and wherein said position information receiver receives via said source a permission from the person to be tracked.

58. Apparatus according to claim 53 or claim 54 and wherein the position information receiver receives an indication of a permission to be tracked directly from the person.

67. The method according to claim 66 and wherein the time after termination of preparation of the digital stream for use is immediately after termination of preparation of the digital stream for use.

68. The method according to claim 60 and wherein said preparing A/V information for display in association with said digital stream comprises at least one of the following: preparing the A/V information for display over a channel associated with the digital stream; preparing the A/V information for display together with the digital stream in a PIP mode; and preparing the A/V information for display together with the digital stream in a side-by-side mode.

69. An anticipatory processing method comprising:
predicting an event determining program material to be displayed; and
preparing an analog channel for use in response to said predicting.

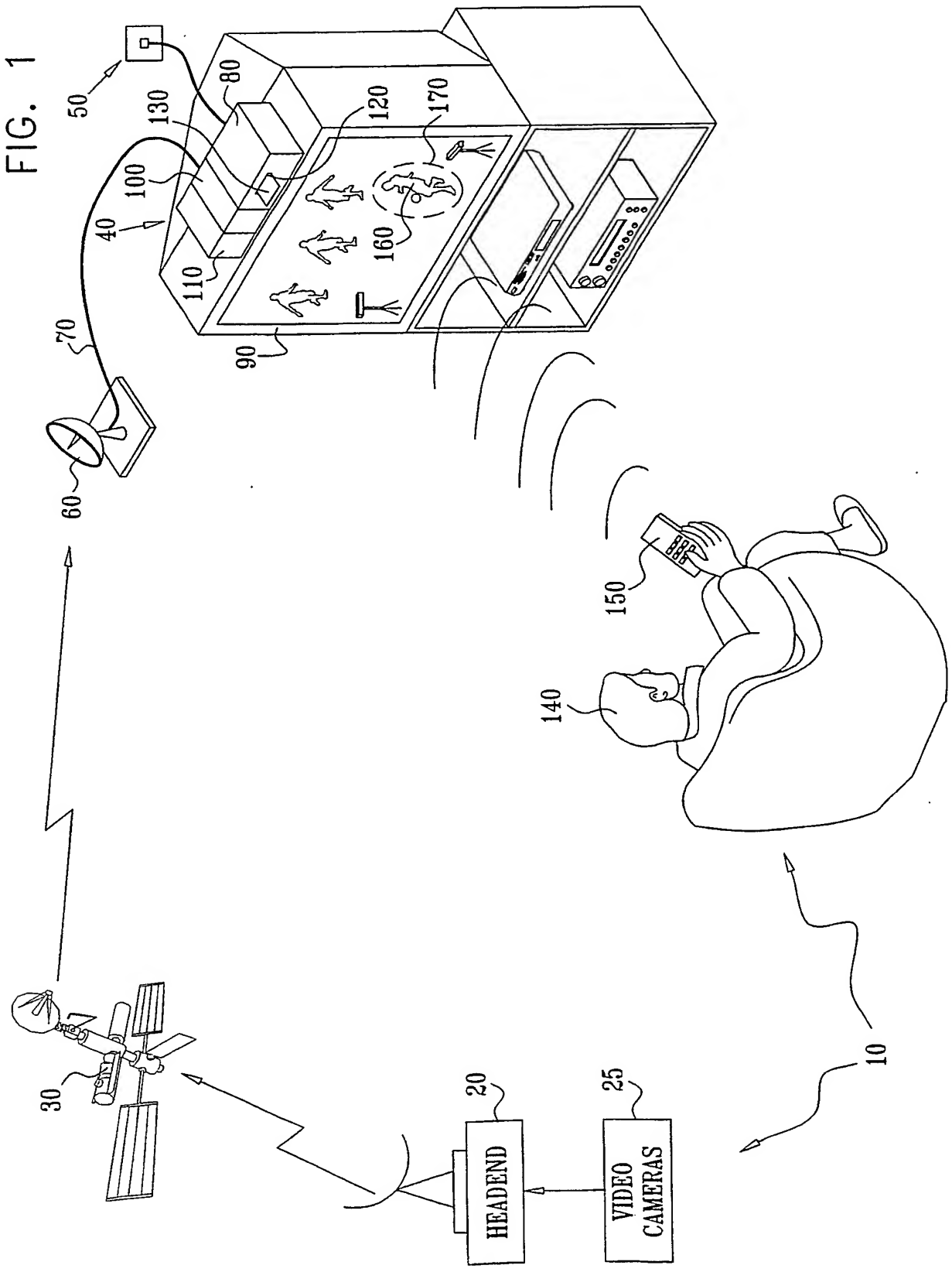
70. The method according to claim 69 and also comprising preparing A/V information associated with said program material for display over said analog channel in response to said predicting.

71. The method according to claim 69 or claim 70 and also comprising using the analog channel if the event occurs.

72. The method according to claim 71 and wherein said step of using comprises at least one of the following: rendering the analog channel over a television display; and recording the program material in a VCR.

73. An anticipatory processing method comprising:
providing a plurality of A/V processors comprising at least a first A/V processor and a second A/V processor; and

FIG. 1


50
80
130
120
170
100
40
160
110
70
90
60
150
140
10
30
20
25
HEADEND
VIDEO CAMERAS

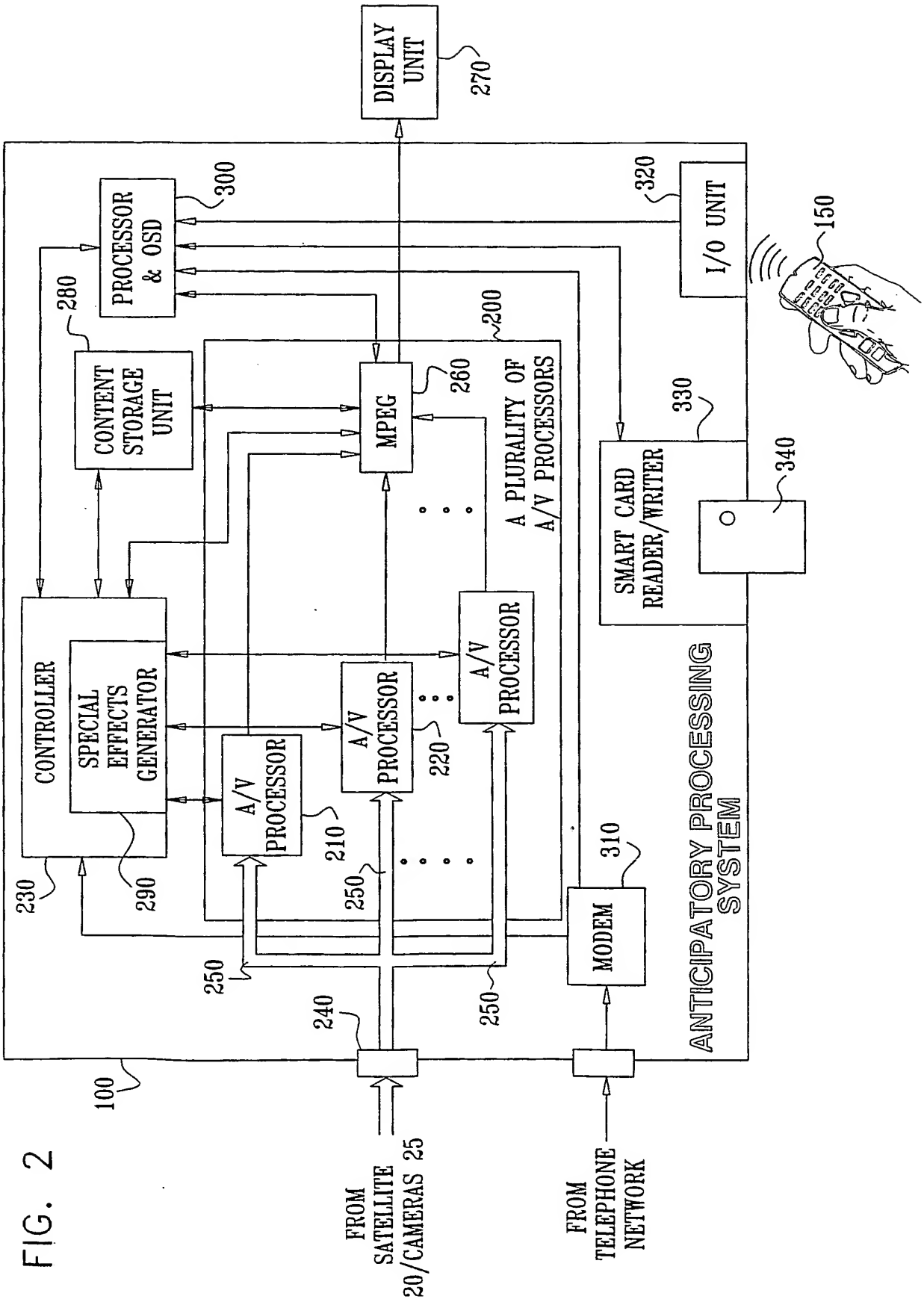

DISPLAY UNIT
270
PROCESSOR & OSD
300
320
I/O UNIT
150
280
CONTENT STORAGE UNIT
MPEG
260
200
A PLURALITY OF A/V PROCESSORS
330
SMART CARD READER/WRITER
340
CONTROLLER
SPECIAL EFFECTS GENERATOR
A/V PROCESSOR
210
A/V PROCESSOR
220
A/V PROCESSOR
230
290
250
250
250
240
MODEM
310
ANTICIPATORY PROCESSING SYSTEM
100
FROM SATELLITE 20/CAMERAS 25
FROM TELEPHONE NETWORK

FIG. 2

FIG. 3

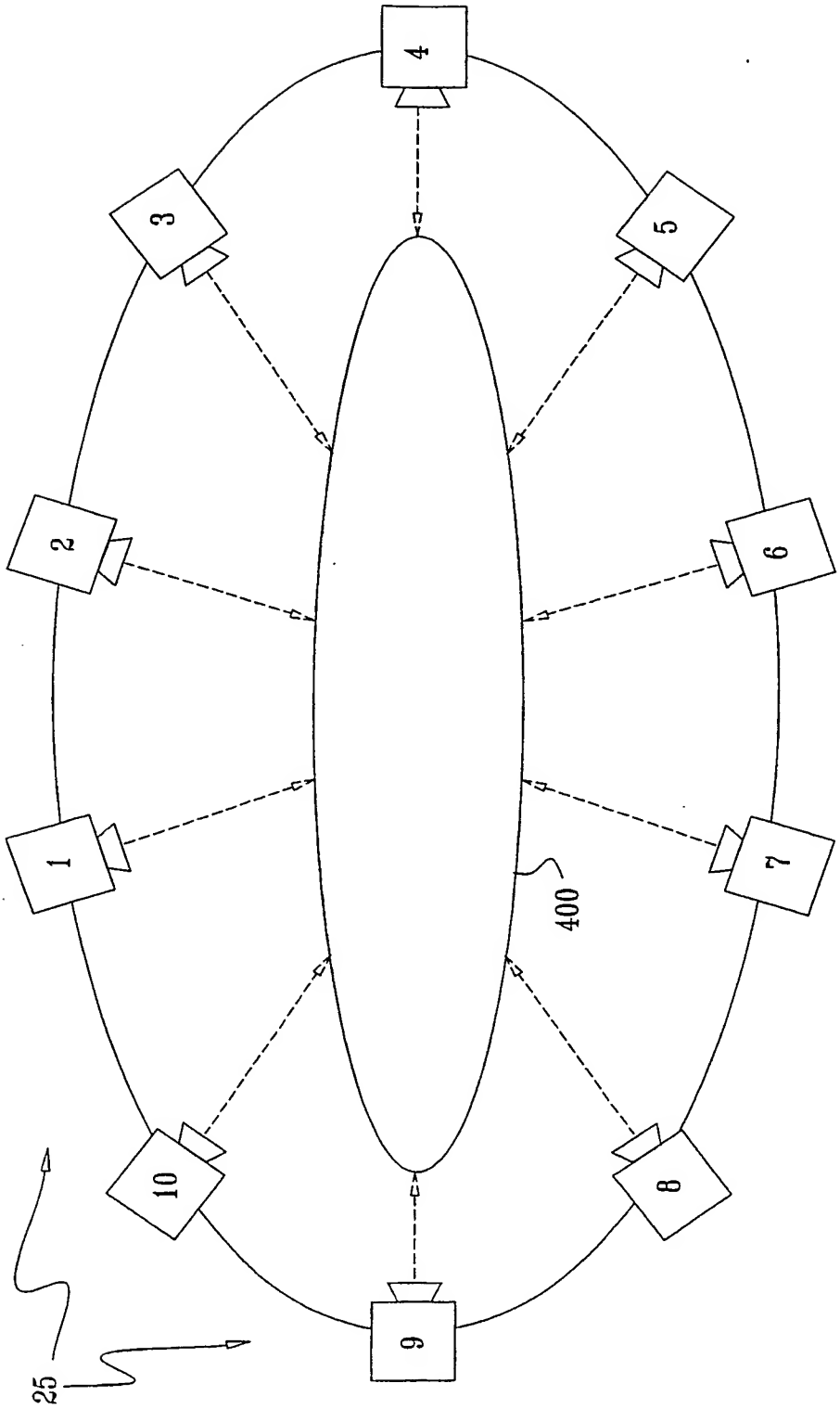


FIG. 4

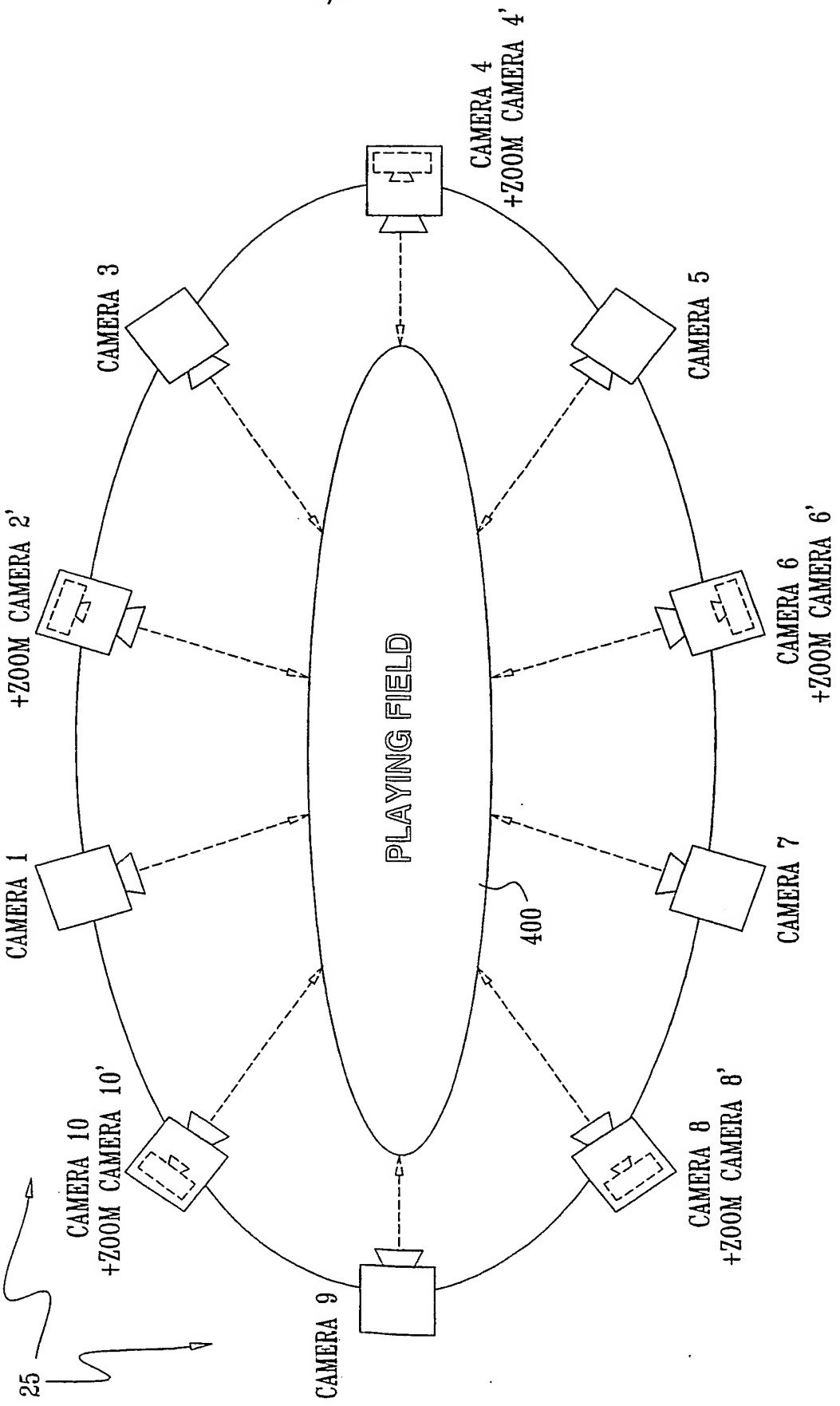

CAMERA 4
+ZOOM CAMERA 4'
CAMERA 3
CAMERA 5
CAMERA 2
+ZOOM CAMERA 2'
CAMERA 6
+ZOOM CAMERA 6'
PLAYING FIELD
CAMERA 1
400
CAMERA 7
CAMERA 10
+ZOOM CAMERA 10'
CAMERA 8
+ZOOM CAMERA 8'
CAMERA 9
25

FIG. 5

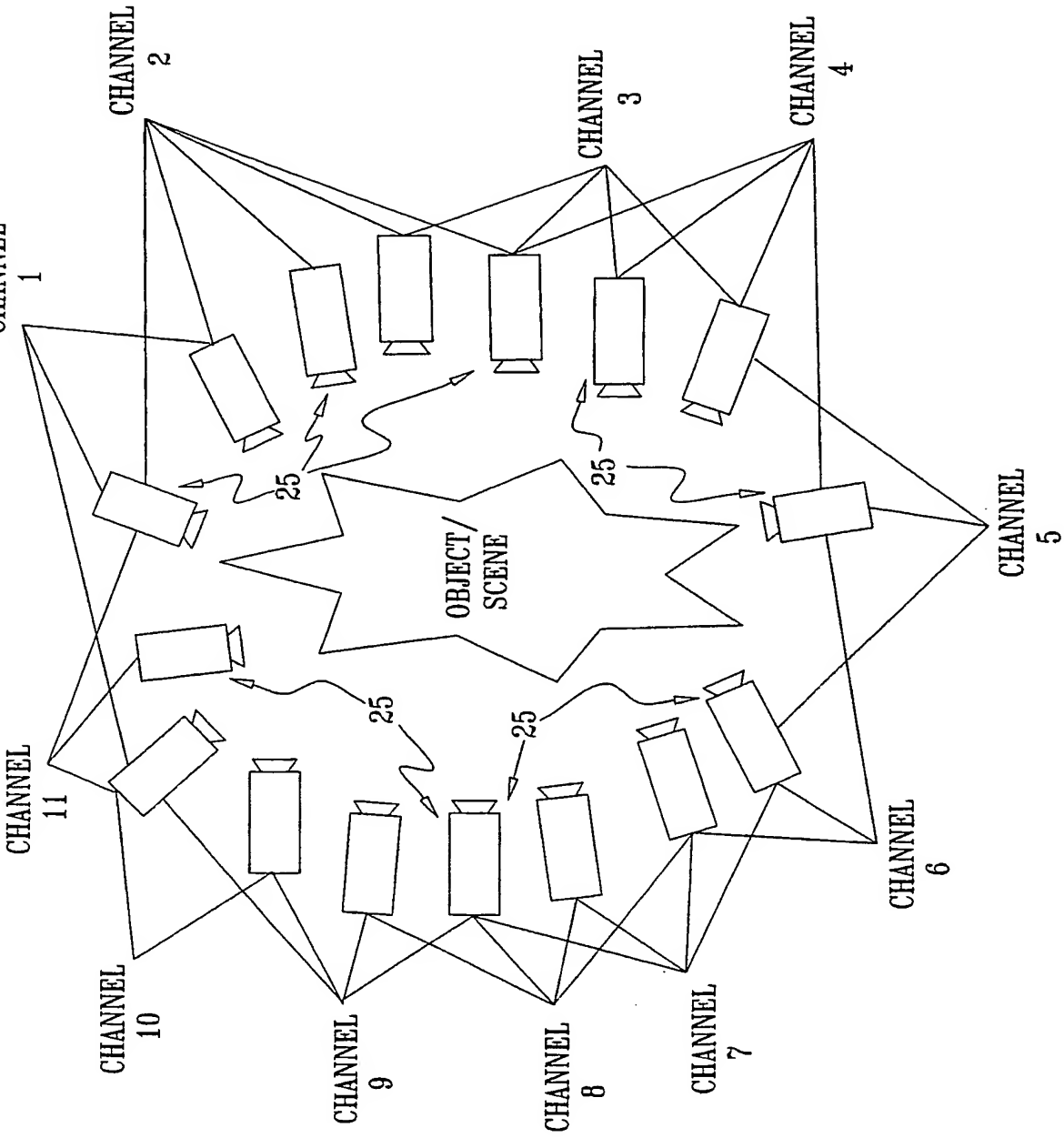

CHANNEL 1
CHANNEL 2
CHANNEL 3
CHANNEL 4
CHANNEL 5
CHANNEL 6
CHANNEL 7
CHANNEL 8
CHANNEL 9
CHANNEL 10
CHANNEL 11
OBJECT / SCENE
25
25
25
25

FIG. 6

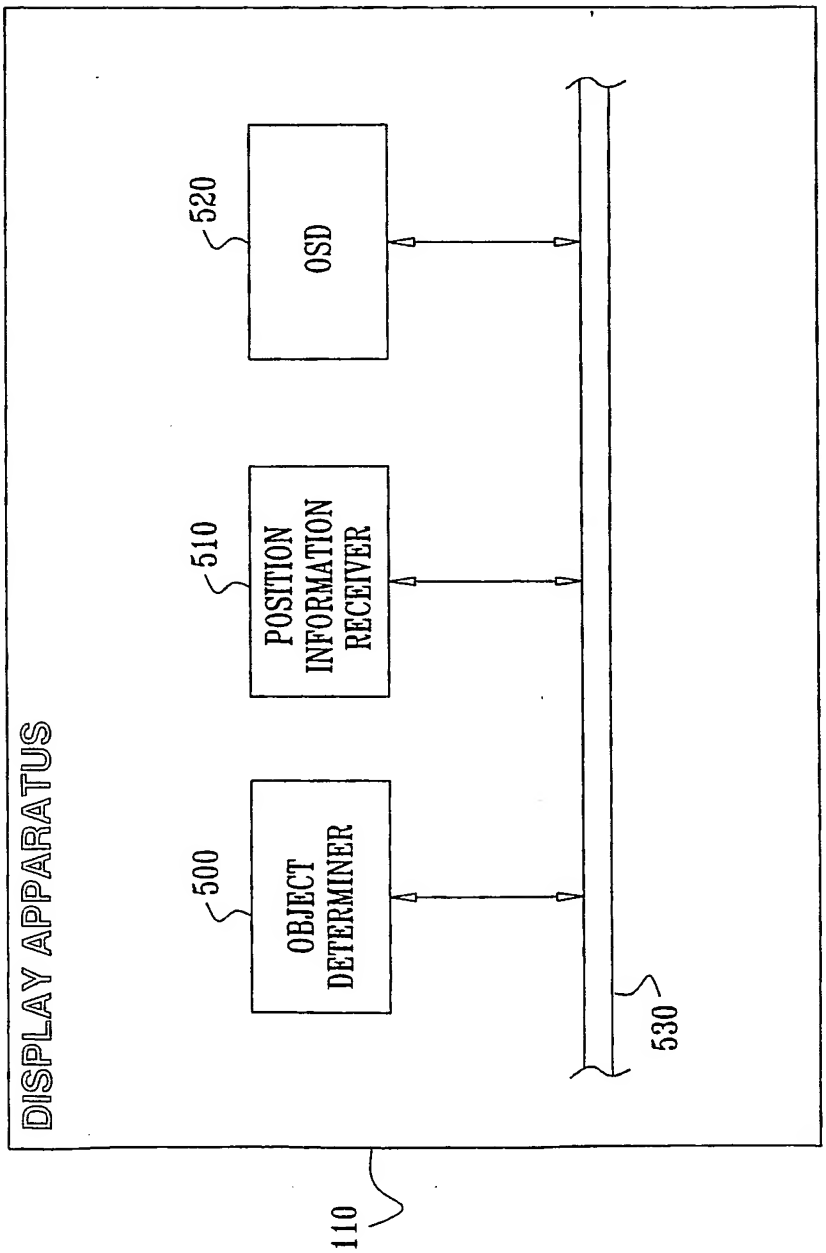

DISPLAY APPARATUS
OBJECT DETERMINER
500
POSITION INFORMATION RECEIVER
510
OSD
520
530
110

FIG. 7

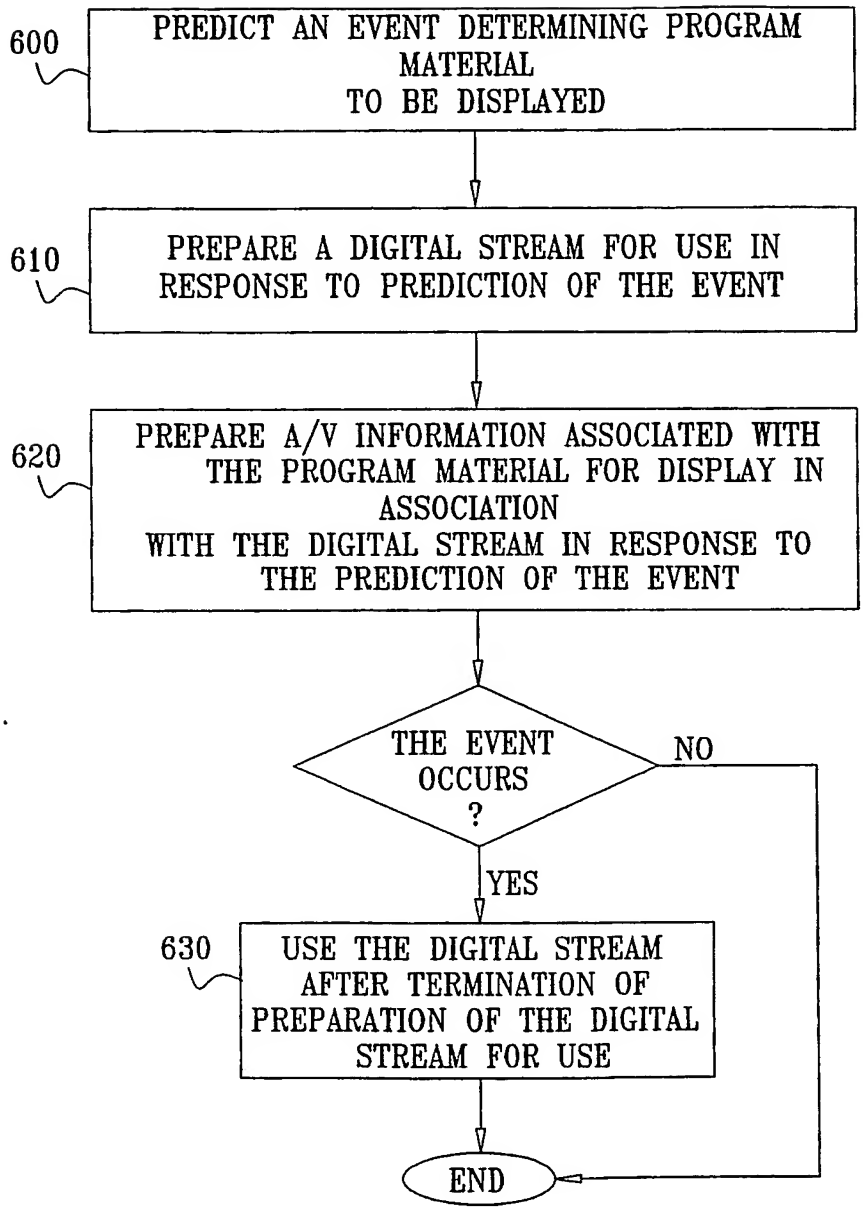
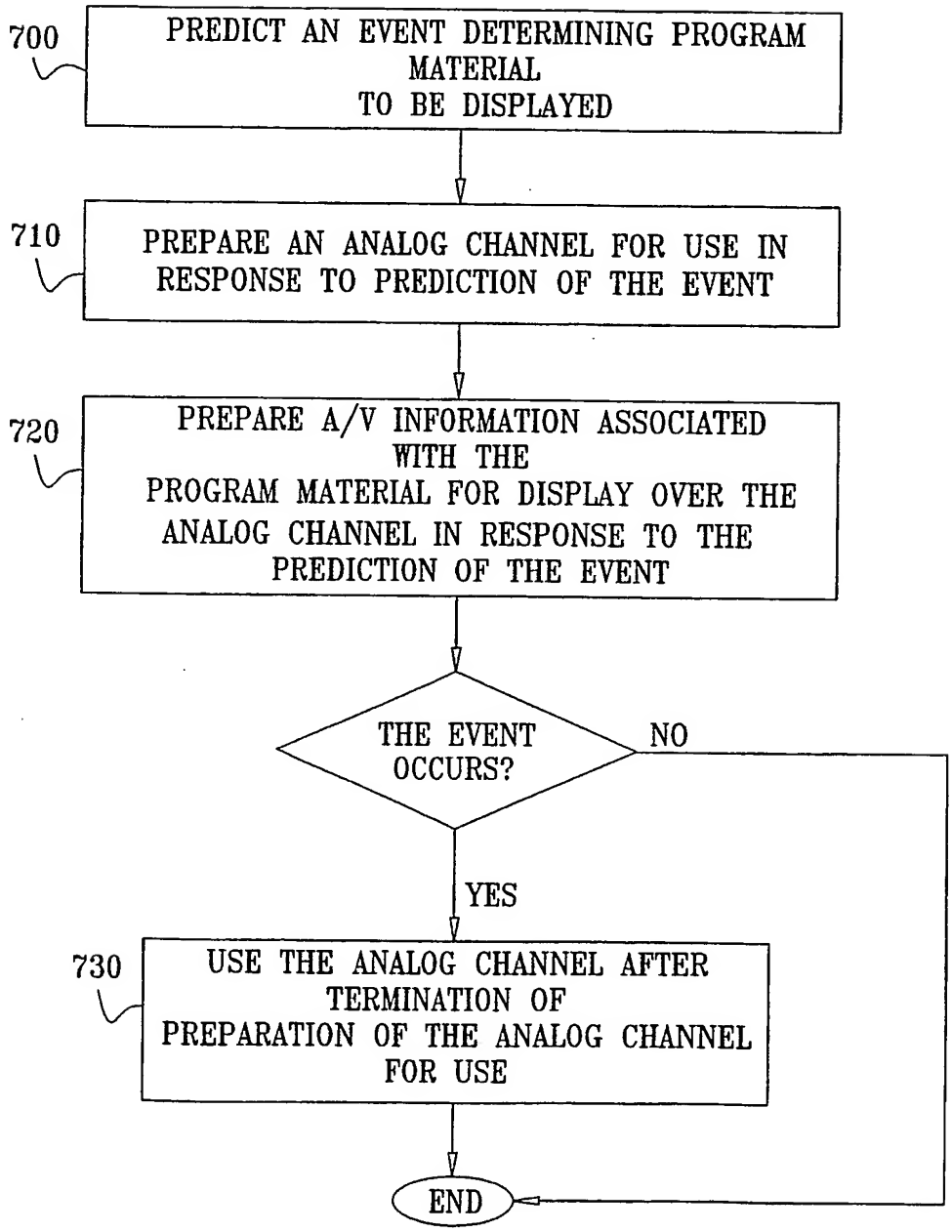

600
PREDICT AN EVENT DETERMINING PROGRAM MATERIAL TO BE DISPLAYED
610
PREPARE A DIGITAL STREAM FOR USE IN RESPONSE TO PREDICTION OF THE EVENT
620
PREPARE A/V INFORMATION ASSOCIATED WITH THE PROGRAM MATERIAL FOR DISPLAY IN ASSOCIATION WITH THE DIGITAL STREAM IN RESPONSE TO THE PREDICTION OF THE EVENT
THE EVENT OCCURS ?
NO
YES
630
USE THE DIGITAL STREAM AFTER TERMINATION OF PREPARATION OF THE DIGITAL STREAM FOR USE
END

FIG. 8


700
PREDICT AN EVENT DETERMINING PROGRAM MATERIAL TO BE DISPLAYED
710
PREPARE AN ANALOG CHANNEL FOR USE IN RESPONSE TO PREDICTION OF THE EVENT
720
PREPARE A/V INFORMATION ASSOCIATED WITH THE PROGRAM MATERIAL FOR DISPLAY OVER THE ANALOG CHANNEL IN RESPONSE TO THE PREDICTION OF THE EVENT
THE EVENT OCCURS?
NO
YES
730
USE THE ANALOG CHANNEL AFTER TERMINATION OF PREPARATION OF THE ANALOG CHANNEL FOR USE
END

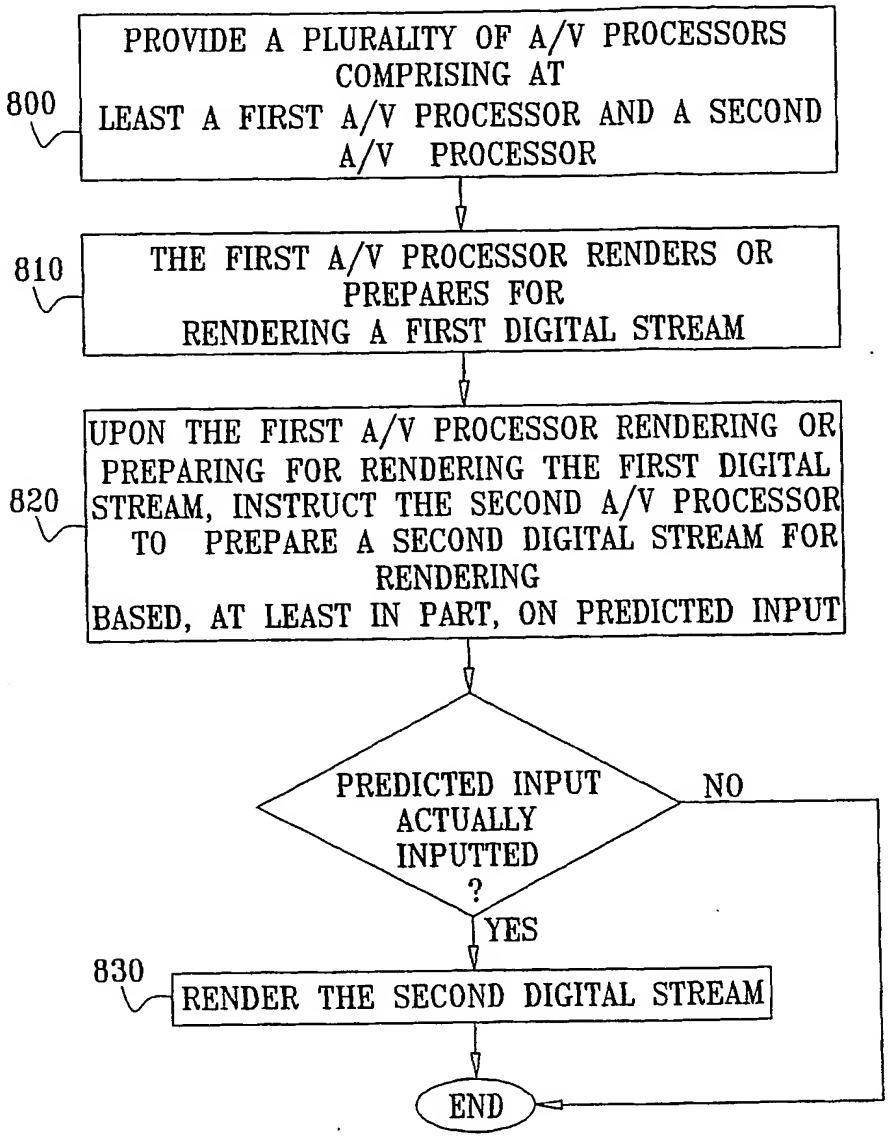
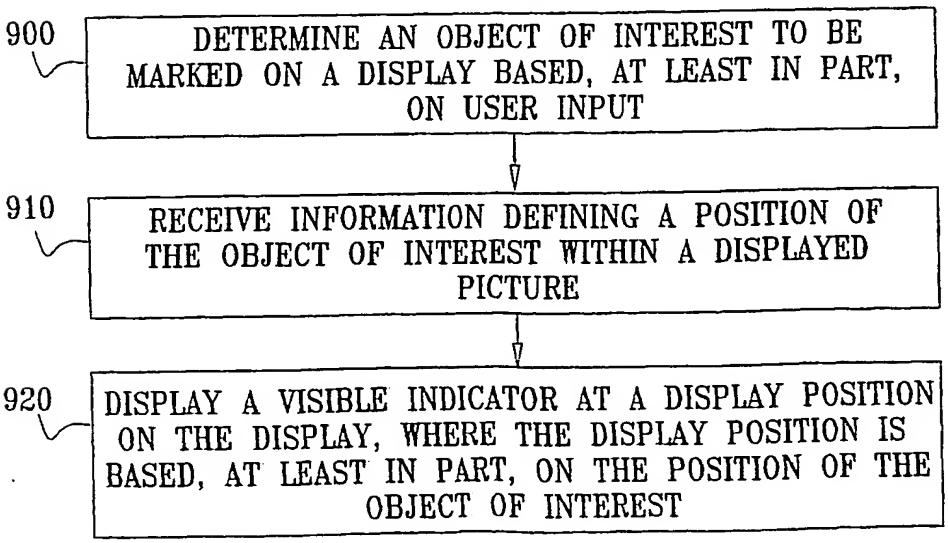

800
PROVIDE A PLURALITY OF A/V PROCESSORS COMPRISING AT LEAST A FIRST A/V PROCESSOR AND A SECOND A/V PROCESSOR
810
THE FIRST A/V PROCESSOR RENDERS OR PREPARES FOR RENDERING A FIRST DIGITAL STREAM
820
UPON THE FIRST A/V PROCESSOR RENDERING OR PREPARING FOR RENDERING THE FIRST DIGITAL STREAM, INSTRUCT THE SECOND A/V PROCESSOR TO PREPARE A SECOND DIGITAL STREAM FOR RENDERING BASED, AT LEAST IN PART, ON PREDICTED INPUT
PREDICTED INPUT ACTUALLY INPUTTED ?
NO
YES
830
RENDER THE SECOND DIGITAL STREAM
END

FIG. 9

FIG. 10


900
DETERMINE AN OBJECT OF INTEREST TO BE MARKED ON A DISPLAY BASED, AT LEAST IN PART, ON USER INPUT
910
RECEIVE INFORMATION DEFINING A POSITION OF THE OBJECT OF INTEREST WITHIN A DISPLAYED PICTURE
920
DISPLAY A VISIBLE INDICATOR AT A DISPLAY POSITION ON THE DISPLAY, WHERE THE DISPLAY POSITION IS BASED, AT LEAST IN PART, ON THE POSITION OF THE OBJECT OF INTEREST

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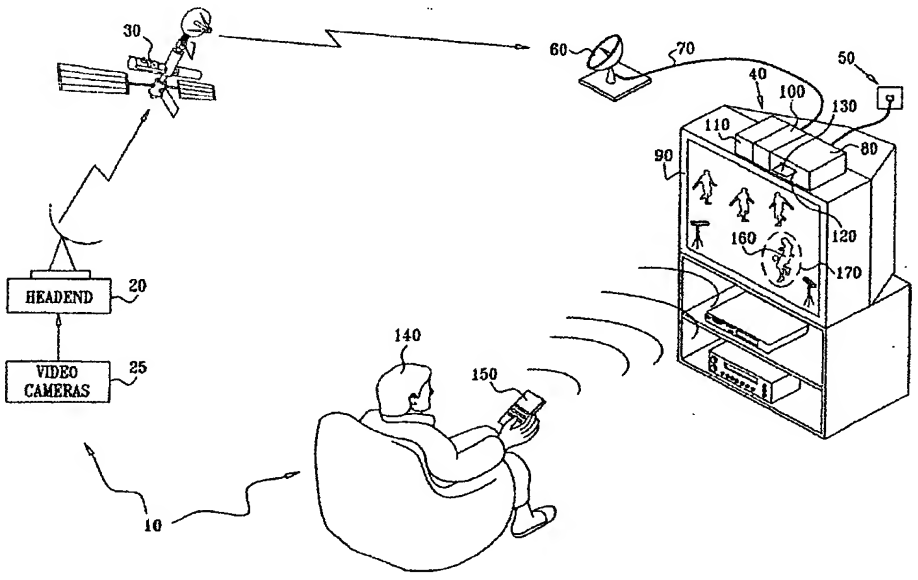
(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

[Continued on next page]

(54) Title: INTERACTIVE BROADCAST SYSTEM



(57) Abstract: An anticipatory processing system (100) is described. The anticipatory processing system (100) includes a controller generating a prediction of an event determining program material to be displayed, and an audio/video (A/V) processor controlled by the controller for preparing a digital stream for use in response to the prediction of the event. Related apparatus and methods are also described.

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International application No.
PCT/IL03/00796

A. CLASSIFICATION OF SUBJECT MATTER
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US CL : 725/32, 34, 36, 42, 37, 38, 61
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 725/32, 34, 36, 42, 37, 38, 61

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
East - predict, commercial, advertisment, insertion, select, object, person

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,177,931 B1 (ALEXANDER et al) 23 January 2001, whole document	1-75
A	US 6,339,842 B1 (FERNANDEZ et al) 15 January 2003	1-75
A	US 6,002,393 (HITE et al) 14 December 1999, whole document	1-75
A	US 5,886,731 A (EBISAWA) 23 March 1999, whole document	1-75

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